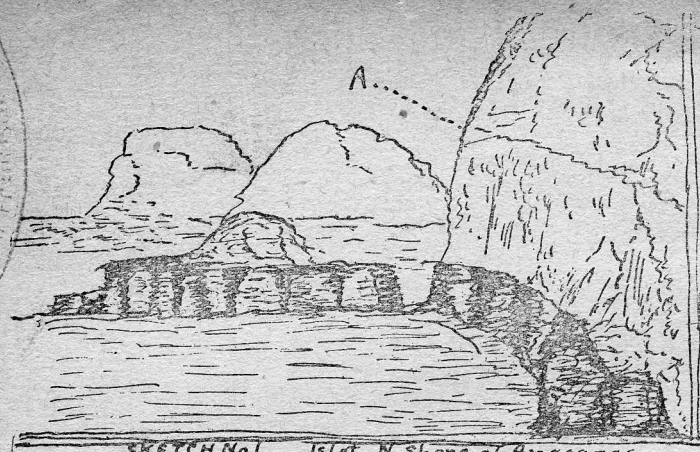
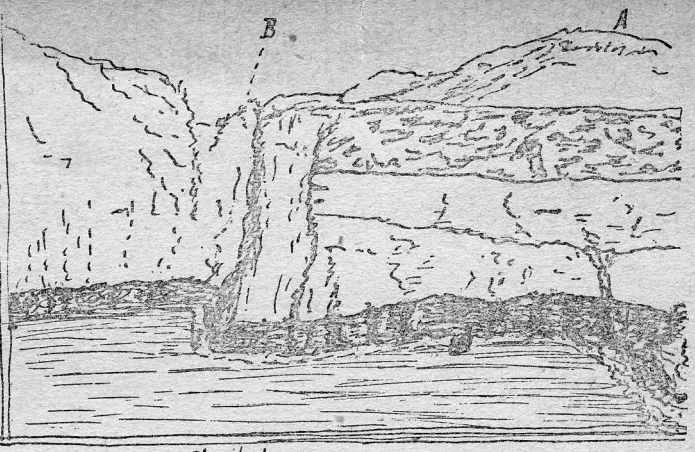
[*From the American Geologist, Jan. 1890.*]

NOTES ON THE GEOLOGY AND SCENERY OF THE ISLANDS FORMING THE SOUTHERLY LINE OF THE SANTA BARBARA CHANNEL.

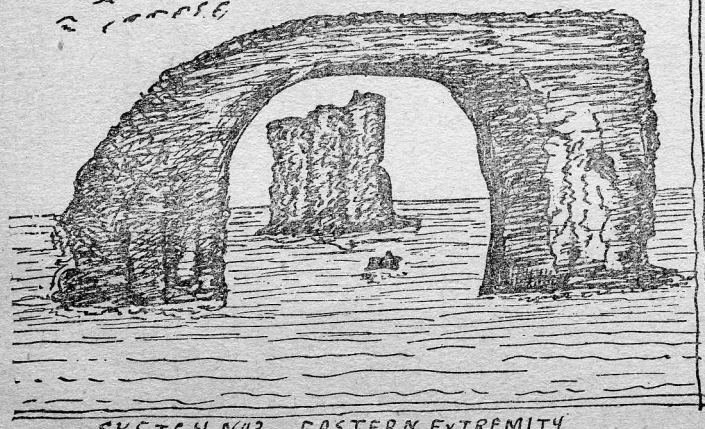
By Dr. Lorenzo Gordin Yates, Santa Barbara, Cal.



SKETCH No1 Islet, N. Shore of Anacapas.
Showing Black Basalt capped by Trachyte



Sketch No 2.



SKETCH No3. EASTERN EXTREMITY
OF Anachapas

SKETCH No4.
S. Side of Anachapas.

California, from the San Miguel off point Conception to the eastern extremity of the Anacapas, is composed of a foundation of black vesicular basalt, upon which rest the later formations of trachyte and other varieties of volcanic rocks.

In many places the older flow of lava has evidently been broken up into irregular fragments, and cemented by the subsequent flow of intrusive lava, which formed a softer rock than the older basaltic formation; hence where this volcanic breccia is exposed to the action of the atmosphere, the intruded cement has disintegrated more rapidly, than the included fragments of the older formation, thus freeing the enclosed fragments which form the debris at the bases of the perpendicular cliffs along the shores of the islands. At other points,(for example see sketch No. 1 on north side of the middle Anacapas) we see the black basalts forming the foundation of the inlet up to about 20 feet above the surface of the water; the soft trachytic rock which formerly covered the basalt, has been eroded, leaving only a rounded elevation in the centre. A short distance from this islet the foundation is capped by a variety of irregularly stratified rocks; First, by a gray basalt; then by a lighter gray; then a dark line of much weathered trachyte, finally, by a light colored greenish gray stratified deposit which forms the present surface of the island.

This formation is shown in sketch No 2, where is also shown a wall of intrusive rock of a dark rusty color, capped by a warm grayish brown. This interesting exposure can be favorably studied from point Lookout, (A. sketch No. 1); which point may be reached by following a well made trail starting at the settlement and following an easterly direction, skirting the northerly line of the uplands, gradually tending downwards until a point is reached from which an excellent view of the west island may be had, also of the natural arches and entrances to the caves,—and higher up in the bluffs of the small wind-worn caves, the varied points and irregularities of outline, the wealth of coloring of rocks, plants, ocean, sky, and even the sea-weeds adding no unimportant item to the panorama.

As seen from this elevation the colors of the clear, calm water of the ocean shade off from bright yellowish brown and brilliant green at the surface, to the depths where the darker hues of brown and green are blended. Even the molluscs

Trochiscus norrissii on the kelp, seem to catch and intensify the colors of their surroundings. Almost directly under us lies the small islet shown in sketch No. 1.

Following the trail a short distance farther we round the point where the north side of the eastern island comes into view, presenting with the eastern portion of the middle island an entire change of color and outline. The shore line is of all shades of brown and green. The black basaltic base, with its overlying masses of trachytic rock of various colors, is weathered out into innumerable cavities and miniature caves. The outlying islets are viewed at an altitude of perhaps 200 feet above the ocean, which lies almost directly under our feet. The barking sea-lions and seals impress us with the idea of distant voices of human beings. The scene has a beauty and grandeur impossible to describe or imagine, and well worth the trouble it costs to reach the locality.

Retracing our steps we regain the higher ground and reach a point on the top of the greenish gray sedimentary deposit shown in sketch No. 2 at A. From this point we see the entire length of the eastern island, and the sinuosities of its southern side; the whole length of the southern exposure shows perpendicular cliffs from the shore to the top of the island some three or four hundred feet high, with the eastern end of middle island and the gray deposit before mentioned in the foreground, and over which at a low point marked "B" in sketch No. 2, we see the shore line of the eastern island, the peculiar form of which resembles the rim of an immense crater, a greater portion of whose circumference has been destroyed by the ocean which is continually battering at both sides of the remainder, which must, at a time not far distant, succumb to the forces of nature which are rapidly disintegrating the remains of what once formed a large extent of country.

The Caves.

Many of the caves on these islands are interesting, one of them which we called Freshwater or Indian cave, shows evidence of having been inhabited by the aborigines for a long period. At the mouth of this cave is a spring of good water seeping from the rocks into basin-shaped cavities which are evidently artificial. One of these fills up at the rate of 70 gallons every 24 hours. Among the refuse matter deposited

in this cave by the Indians we found but little except some fragments of ropes made of sea-grass. Some of these ropes were braided with three strands,the others twisted like ordinary rope used at the present day. We found also bones of a variety of animals which had been used as food.

The largest cave on the Anacapas into which we rowed our boat consists of a chamber of about 400 feet in width, running back about 150 feet from the arched entrance, with a dome-shaped roof perhaps 100 feet high, rising from the circumference in a regular curve to the center. The floor of this cave is covered by water, and edged by a pebbly beach which extends around the interior, upon which we landed. Another which we called the Dark cave, is in the shape of a long gallery just about large enough to admit a small row-boat, but extends for some distance. It is divided into three distinct chambers, the openings between being so small that we had to bend over in order to pass through. The interior was so dark that, although we had two candles burning we could only tell where the walls were by alternately bumping our heads and elbows against them.

In passing along the bluffs in which the caves are situated, they present a panorama of unique and beautiful scenery, where the richness of color and peculiarity of outline are unequaled at any other point, the water for a great portion of the distance being perfectly calm, and so transparent that the flora and fauna of its depths may be as easily studied as upon the surface; bright orange-colored fishes darting in and out among the dark green sea-weeds, the shells, corallines and other inhabitants of the deep can there be studied in their native element.

The passing of every point opens up a new view in kaleidoscopic succession of picturesque beauty; steep weather-worn faces of perpendicular bluffs; deep fissures and wierd, mysterious caverns, from the tide-worn recesses of which issue the loud and continuous barking of seals; the undulating lines of flying flocks of brown pelicans; the ever changing colors of sea and shore, keep one continually on the lookout, that no portion of the interesting panorama be missed.

The interest increases until it culminates on reaching the Grand Arch at the eastern extremity of the group (see sketch

No. 3), where from a distance we may study the manner in which the islands have been encroached upon by the ocean.

The line of the surface of the eastern extremity of the group, and the tops of the outlying rocks, evidently formed portions of the same original slope, through which the sea made openings or passages which in time caved in from the top and formed distinct islands and outlying rocks still projecting above the surface of the water.

In this manner the islands have been broken through at the weakest points, thus dividing the Anacapas into three distinct islands; and the channels between the principal islands of the chain have doubtless been formed in the same manner.

The middle and eastern Anacapas are composed entirely of volcanic rocks with the exception of a superficial deposit of water-worn pebbles and fragments of quartzose and metamorphic rocks extending diagonally across the top of the middle island near its southeasterly corner, and from which the aborigines selected material for the manufacture of their weapons. Many of these fragments show evidence of having been broken and flaked off by the hand of man.

At a point on the south side of the island there is a deposit of limestone a few feet below the surface. Another deposit of drift occurs at the easterly end of the west island; a vein of milky chalcedonic quartz of about 10 inches in thickness is seen some 15 or 20 feet below the drift near the arched passage or "Natural Bridge" near the east end of the west island.

Westerly from the latter point this stratified uplifted rock rises abruptly until it attains a hight of almost 1,000 feet, with a dip of 45 degrees toward the north. This portion of the island was not explored to any extent, except as we rowed or sailed along the channel side where the bluffs rise perpendicularly from the water. At the beach near the "Natural Bridge" the prevailing rock is an amygdaloid and vesicular basalt containing spherules of zeolites.

The basaltic base of the middle island is composed largely of black vesicular basalt, containing spheroid and amygdaloid pebbles of chalcedony, which weather out and roll down the banks in the form of marbles. Some of these are solid, others are hollow and lined with drusy quartz.

Santa Cruz.

I had intended to make an examination of the island of Santa Cruz, but was refused permission to land for that purpose by the Santa Cruz island company, so that I can only give notes on some widely separated localities; but as Prof. Goodyear of the state survey spent some time on that island last spring, we shall learn something of its geology from the published reports of the survey.

At Smugglers' harbor, near the southeasterly extremity of the island we found an interesting exposure, where the basalt volcanic breccia and white bituminous shale may be seen in juxta position, the shale twisted and contorted by uplift of the underlying rock; the breccia composed of irregular fragments of vericular basalt cemented by trachytic cement.

Twenty-five miles from Smuggler's harbor, at the northwestern extremity of Santa Cruz, Forney's cove affords a safe and convenient harbor, protected by a narrow neck of basaltic rock extending southwesterly from the main island.

From Forney's cove we follow the coast of the island, composed of perpendicular basaltic rocks similar to those of the Anacapas to Lady harbor; just before reaching which we visit a beautiful cave with three openings, one towards the west, one towards the south into which the water of the ocean extends some distance affording a good landing on its pebbly beach; the other opening towards the east at the mouth of a wooded cañon which from this point rises rapidly towards the high mountains which are here but a short distance from the north shore. The westerly opening of this cave is exquisitly beautiful, the large arch and roof showing the minute details of the conglomerates, the irregular fragments of which lie scattered about, and project from the cementing material from which they are continually weathering out, leaving a ragged surface among the projecting points of which Polypodiums, Penstamons, and other interesting plants flourish in the greatest luxuriance. I have never seen such a magnificent growth of Polypodiums elsewhere as I saw fringing the mouth of this beautiful cave.

Santa Rosa.

The longer axis of Santa Rosa island, as also of the other Channel islands is parallel with the coast and the Santa Ynez range of mountains.

Its general outline is in the form of a parallelogram, its greatest length about 18 miles, and greatest width about 12 miles, with a shore line of nearly 45 miles.

On the northeastern side of the island and midway between the north and west points a reef extends out to a distance of one and a quarter miles.

The channels between this island and Santa Cruz on the east, and San Miguel on the west are respectively six miles and four miles in width.

The outline of the island is bold and no harbors exist around its shore, but there are several good landing places, and a wharf has been built about the centre of Five-mile bight, where vessels can load and unload in safety.

This island had been described as composed of sandstone, but the first thing noticeable on landing at the west end of the island was the volcanic character of the rocks.

At the wharf we found a good exposure of strata forming cliffs about 30 feet in hight, the lower portion, for 15 feet above the sand of the beach, composed of stratified sandstone, fine grained and destitute of fossils, with an occasional stratum of breccia or conglomerate. These strata have a dip of about 12 degrees southeast. The upper portion of the cliffs consists of a horizontal deposit of fragments of rhyolite, trachyte, vesicular basalt, and white bituminuos shale. The fragments gradually decrease in size from the bottom where they are cemented together by volcanic sand; this is covered by deep and apparently good soil.

In some places the rock fragments of the upper half of the cliffs have been water-worn and form conglomerate.

This character of rock extends from the wharf southeasterly to near the sand point at the southeastern extremity of the island, where it culminates in a hill of volcanic rock 175 feet high, which is exposed for some distance in a southeasterly direction from the beach on the north side of the point.

The rocks have a marked tendency to weather into fantastic forms, the angular rocks becoming rounded by disintegration, with irregular cavities and caves worn by the winds which have been used as dwellings by the aborigines as is indicated by fragments of shells and other debris in large quantities.

At the northeastern extremity of the island is found a coarse

volcanic breccia, composed of porphyritic and trappean rocks, having a distinct stratification with a dip of 30° southeast.

Several spurs extend out some distance from the shore line, and others have been worn away by the surf until they form small rocky islets, while the porphyritic rocks, which have weathered out of the breccia, lie as smooth bowlders at the base of the cliffs.

From this point the hills rise sharply to a hight of from 250 to 300 feet, and run southeasterly to the main backbone of the island which lies on the line of its longest axis.

The highest points on this range were visited, and the altitude was found to approximate 1,400 feet.

Several high peaks are grouped together about five miles south from the wharf, being on the northern side of the line of the long axis of the island.

Three of these high peaks lying within a mile circuit were measured, the first, Black mountain, indicated a hight of 1,325 feet; crossing from this peak over a depression of 350 feet below the first summit we find rhyolite and white bituminous shale. The next peak south, (Saddle mountain) is about 100 feet higher than Black mountain.

Between this point and the hills on the southeastern side of the Cañada de la Cruz (Cañon of the Cross), we found limestone in the bed of the creek, together with fossil oysters (Ostrea titans) and other Miocene fossils. Southeasterly from Saddle mountain, and lying between Cañada de la Cruz and the ocean there is an intrusion of syenite, the extent of which has not been ascertained, nor did I discover the line of junction between the Miocene and Pliocene.

On the north side of the island, about ten miles from the wharf, near the mouth of Saledad Cañon, we found an excellent exposure of strata, consisting of about 90 feet of Post Pliocene deposit, containing fossil bones of vertebrates, and at one place, fossil Physas, (P. d'orbigniana), at a depth of some 75 feet below the surface.

This deposit is horizontal and overlies strata of older rocks, probably Pliocene, which dip 13° N. E. and contain Pecten, Turbinella cæstrum, and Hinnites gigeantea in abundance, and in an excellent state of preservation.

From this point to the southwestern extremity and around the west end of the island to the point where the main range of

mountains meets the ocean, the shifting sands have covered the rocks. There is no indication of drift on Santa Rosa island, hence we cannot account for the presence of the fossil elephant on the theory of its having been brought by floating ice, as advanced by some writers. It will be observed that the Anacapas Santa Cruz; Santa Rosa and San Miguel islands are on a line with point Dumas on the east and are parallel with the Santa Ynez mountains as before stated; at this point the islands were doubtless once connected with the main land, and what is now the Santa Barbara channel was then a gulf or arm of the sea, beginning at point Conception and running in a southeasterly direction for, say 150 miles.

When these islands were thus connected with the mainland, it was easy for them to become inhabited by the larger vertebrates.

It is also probable that this chain of islands is a portion of the same outflow of lava which formed the volcanic ridges and peaks on the mainland east of them.

Santa Barbara Daily INDEPENDENT January 9th 1890,

The columns of this paper have frequently been adorned by articles of sterling, original, scientific value signed by Dr. Lorenzo G. Yates. Probably few men in this country are more widely known in foreign scientific circles than he. Dr. Yates in addition to being a Fellow of the Linnean Society and other foreign scientific Institutions has just been elected a "Fellow of the American Geological Society" and a "Member of the New Zealand Institute." This last named society is similar to the "Royal Society" of England. It publishes voluminous transactions which are eagerly sought for all over the world. Not every learned scientist has the high honor of being a member of this institute. A letter was lately received from Eucador stating that Padre Luis Sodiro of Quito, Ecuador, has honored Dr. Yates by giving his name to a new fern. Padre Sodiro is one of the ablest scientists of the country and has lately published a magnificent monument of his labors entitled "Recensio Cryptogarum Vascularium Provinciæ Quitensis." It is written in Latin and is the most complete work of its kind ever published. Dr Yates is at present engaged in writing several articles for the State Geologist of California, on the "Geology of the Channel Islands." These articles are to be embodied in the forthcoming report of our State Geologist. From these above notes it is easily seen that our city is having lustre added to its name in having as a citizen a man who is so well known in the scientific world.